411-051-8864-A

IDENTIFY ESSENTIAL ELEMENTS OF TERRAIN INFORMATION FROM STANDARD REMOTE SENSED IMAGERY (INDUSTRIAL FACILITIES)

TEC Lesson 411-051-8864-A

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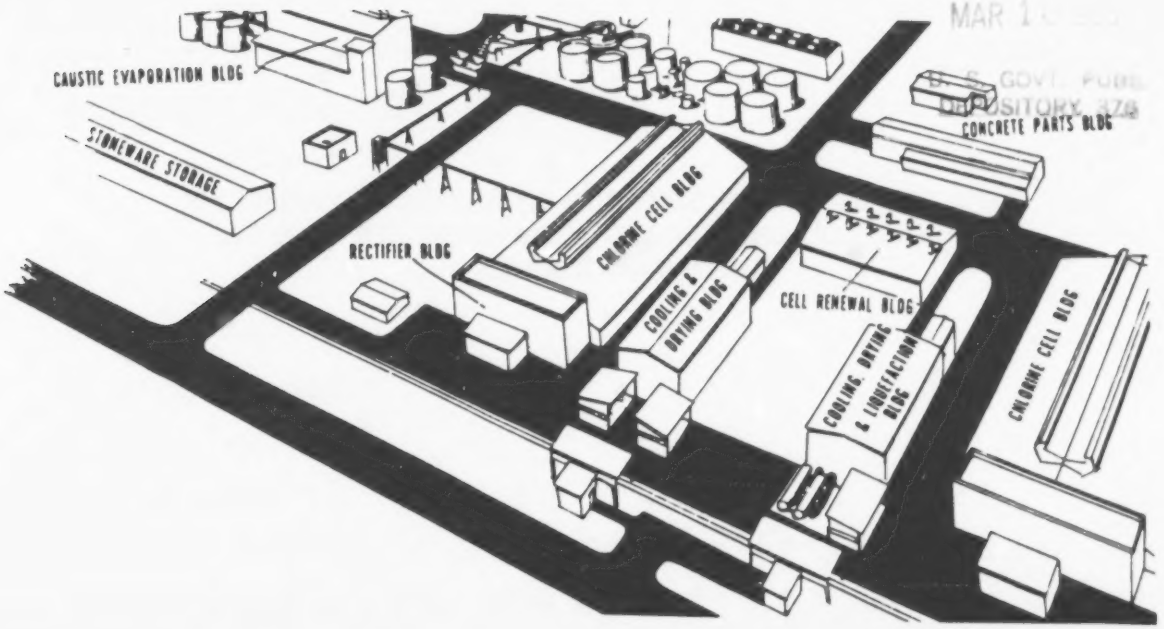

PRODUCED BY
UNITED STATES ARMY
ENGINEER SCHOOL
FORT BELVOIR VIRGINIA

STUDENT/SUPERVISOR INSTRUCTIONS, PRE-TEST/POST-TEST, AND ANSWER KEY ARE CONTAINED IN THIS BOOK

NOVEMBER 1985

copy available

If you have questions or comments concerning this TEC Lesson, address them to:

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* Current symbol may be obtained from DA Pam 350-100, Appendix C.

READ THE STUDENT/SUPERVISOR INSTRUCTIONS CAREFULLY. BE SURE YOU UNDERSTAND THEM COMPLETELY BEFORE CONTINUING THE LESSON.

The words "he," "his," and "men," when used in this publication, represent both the masculine and feminine genders, unless otherwise specifically stated.

STUDENT/SUPERVISOR INSTRUCTIONS

AUDIENCE:

- MOS 81Q – Terrain Analyst
- Skill Level I & II

TRAINING OBJECTIVE:

- Identify Types of Extraction Facilities
- Identify Processing Industries
- Identify Fabrication Industries

MATERIALS/EQUIPMENT:

- TEC Booklet
- Pocket Stereoscope
- Writing Materials, Pencil
- Photos

TIME REQUIREMENT:

- No time limit

REFERENCES:

- FM 30-10, Military Geographic Intelligence (Terrain), Chapters 7, 8, 9.

SOLDIERS MANUAL AND TASK NUMBER:

- STP 5-81Q 1 and 2
- TASK NO.: 051-259-2016

STUDENT INSTRUCTIONS

- If you have not taken a printed text TEC lesson before, ask for assistance.
- Work through this lesson as many times as necessary to master all skills and knowledge covered by the lesson.
- Use the tables provided with this text to make computations.
- Follow instructions—DO NOT TAKE SHORT CUTS.

SUPERVISOR INSTRUCTIONS

- This lesson is self-contained and needs no special consideration when used in the individual mode except gathering the required equipment and/or materials.
- Administer the pretest to determine if the soldier should take the lesson.
- Use the posttest to determine if each soldier has mastered the skills and knowledge covered in this lesson or if he needs to retake the lesson.
- If possible, administer a performance test to the soldier upon completion of the lesson.
- When using this lesson for groups:
  a. Administer the lesson to no more than ten soldiers at a time.
  b. Make sure the soldiers have all the required materials and equipment.
  c. Remind the soldiers to use the tables provided with this lesson.

PRETEST/POSTTEST

TEC LESSON 411-051-8864-A

IDENTIFY ESSENTIAL ELEMENTS OF TERRAIN INFORMATION FROM STANDARD REMOTE SENSED IMAGERY (INDUSTRIAL FACILITIES)

You will need a scratch paper and pencil. This test consists of ten questions and tests every training objective in the lesson. Write your answers on a separate sheet of paper. After completing the pretest, check your answers against the "Pretest Answer Key" at the rear of the lesson. These questions have a total value of 100 points. If you do not get at least 80 points, take the lesson. DO NOT WRITE ON THIS TEST.

PRETEST/POSTTEST

TEC LESSON 411-051-8864-A

Title: Identification of Industrial Facilities

1. Three major categories of industrial facilities are:
   a. _____
   b. _____
   c. _____

2. Excavation pits, power shovels and bedding exposures in sides of hills are examples of: _____
   a. Extraction facilities
   b. Processing facilities
   c. Fabrication facilities

3. Name the industrial facility which has these PI keys:
   a. Pumps
   b. Derricks
   c. Pipelines
   d. Storage tanks

4. Which major category of industrial facilities include the following:
   a. Mining operations
   b. Sand/gravel pits
   c. Crude oil exploration

5. Two examples of mechanical industries:

   a.

   b.

6. Gas holders, acid storage tanks, cooling towers and pipelines are examples of which facility?
   a. Heating
   b. Petroleum
   c. Chemical
   d. Quarries

7. Large chimneys, blast furnaces, cooling towers, large quantity of fuel are characteristic of:
   a. Mechanical facilities
   b. Construction facilities
   c. Heating facilities
   d. Chemical facilities

8. Give two examples of a chemical industry:

   a.

   b.

9. From the following PI keys, identify the type of fabrication industry:
   a. Most activities hidden
   b. Rail lines entering buildings
   c. Steel framed buildings
   d. Heavy lifting equipment

10. Highway vehicles, packed containers, wood-framed buildings, loading platforms, and light handling equipment are characteristics of:
    a. Oxygen plant
    b. Heating plant
    c. Heavy fabrication
    d. Light fabrication

THIS ENDS THE PRETEST/POSTTEST

INTRODUCTION

A nation's industrial facilities are one of the basic components of its economic backbone. They process raw material and manufacture finished products to support and produce new weapon systems and equipment for the modern army.

Each type of industrial complex has its unique raw materials, equipment, building structure and waste materials associated with its existence. Many of these components can readily be identified on aerial photographs. By studying their patterns, arrangements, shapes, tone and associated components, the analyst can accurately determine the type of facility in operation.

Illustrations in the text should be used with caution. You may encounter a situation where an industrial plant in one country may look superficially different from similar plants in another country. However, many of the identification characteristics may be present. The analyst must therefore be familiar with the pattern and activities which are unique to industrial facilities.

This test lists many general and specific photo identification characteristics for major industrial facilities. The use of some or all of the characteristics can aid in the identification process.

TEC LESSON

IDENTIFY TYPES OF EXTRACTION FACILITIES

Extraction industries are associated with those activities that pull out or withdraw selected materials such as oil, aggregates and minerals from the earth. The most common ones are typified by petroleum industries, rock quarries and pits, and mining operations such as coal, sulphur and bauxite.

Because of their military importance, terrain analysts must accurately identify from aerial photography the different types of extraction industries and associated facilities within the area of operations.

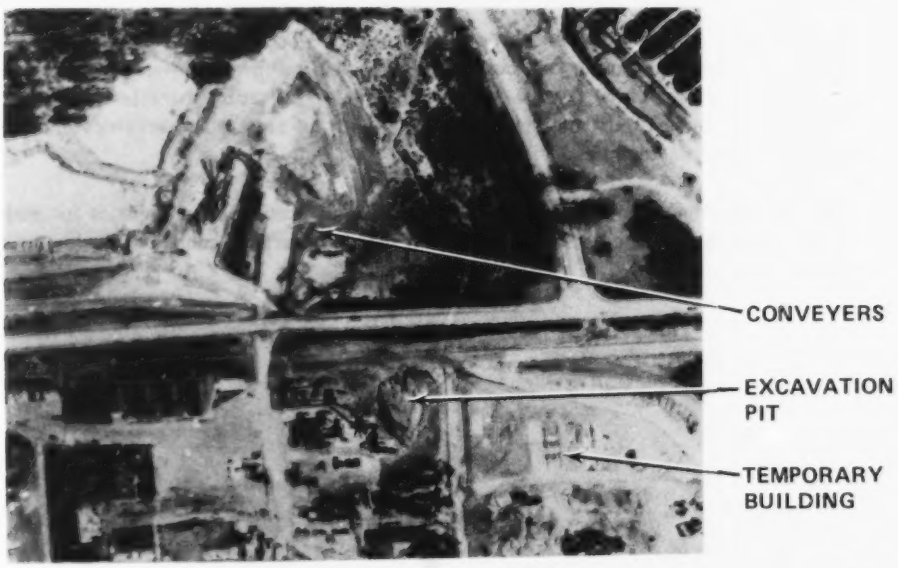
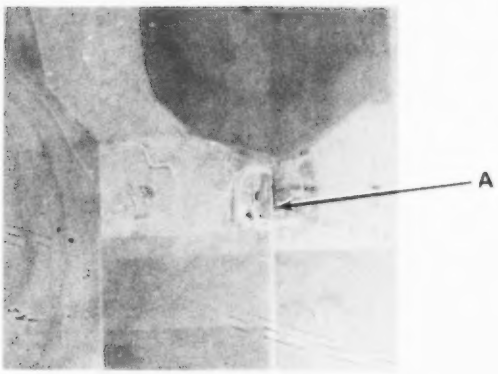


FIG. 1 THIS DIAGRAM SHOWS AN EXTRACTION FACILITY LOCATED NEXT TO A HEAT PROCESSING PLANT



PICTURED IS AN OIL EXTRACTION FACILITY. "A" IS A FLOATING OIL RIG

FIG. 2 PETROLEUM EXTRACTION

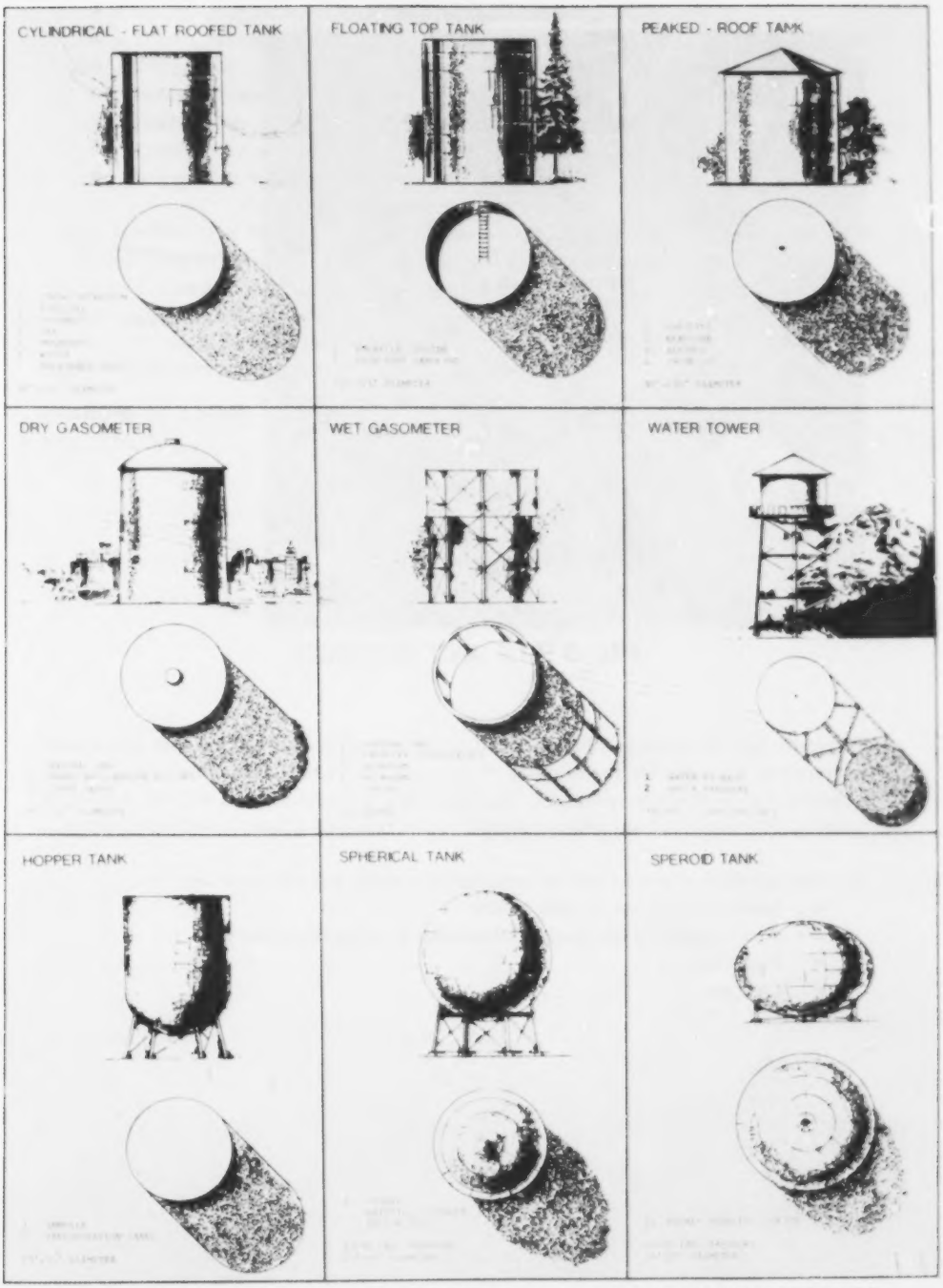
Oil or petrol extraction facilities are generally recognized by the presence of derricks, drilling rigs and pipelines. On vertical areial photographs, the shadows of drilling equipment are very conspicuous and can readily be identified. Other oil-drilling identification keys are:

- Possible oil tankers next to a floating rig
- Oil storage tanks
- Cranes
- Grid-like road net in area of operation
- Few small temporary buildings
- Piles of wood and pipings
- Pumps
- Dark-toned sludge ponds

- Fixed roof cylindrical tanks. These may be peaked, flat, or dome shaped.
- Spherical, spheroidal and noded tanks
- Hopper tanks
- Wet and dry gasometers
- Ponton or floating top tanks

The exploration methods for both natural gas and crude oil extraction are basically the same. However, the presence of natural gas containers at an exploration site may be the one photo identification characteristic which may tell the analyst that natural gas is being extracted at that site. Refer to Table 1 for illustrations representing gas storage tanks, and how they may look on aerial photographs.

Table 1



STORAGE TANKS ILLUSTRATE THE SHAPES OF THE MOST COMMON STORAGE TANKS USED IN THE CRUDE OIL/NATURAL GAS INDUSTRY

Rock Quarries and Pits

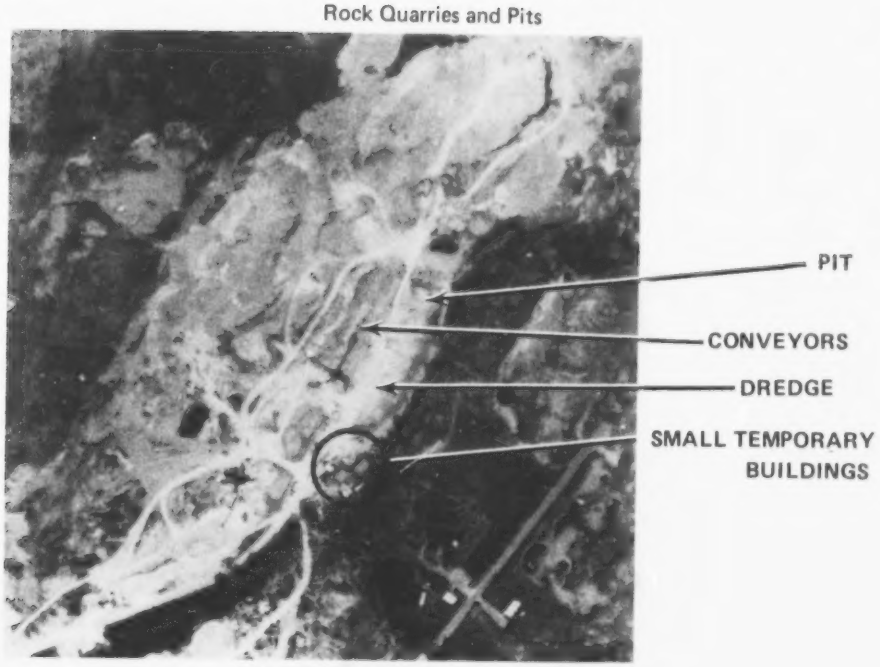


FIG. 3 PITS AND QUARRIES

A secono type of extraction industry is quarries and pits. *Quarries* are sites where open excavations are made for the purpose of removing rock which is suitable in quality and quantity for construction purposes. Usually this is accomplished by drilling, cutting or blasting. *Pits* are sites from which materials can be removed, generally without blasting.

The identification characteristic for recognizing quarries and pits are:

- Bedding exposures in sides of hills
- Clear vegetation with bedrock fractured by systematic blasting
- Power shovels
- Crushers

- Maintenance facilities for crushers, shovels, dippers, truck beds
- Trucks, rail cars
- Conveyors
- Few small temporary buildings
- Draglines/scrapers
- Loading ramps
- Depressions or pits

These identification keys will generally give you an accurate indication of the type of extraction site being interpreted. However, pits and quarries are further classified by the type of material being excavated. These are more difficult to photo identify. Table 2, "Classification of Pits and Quarries" gives the types, material being excavated and the equipment used for excavation. Having knowledge of the type of equipment used for specific materials, may help the analyst identify the type of pit or quarry in operation.

Table 2

CLASSIFICATION OF PITS AND QUARRIES

Type	Material	Primary use	Water condition	Operation and equipment
PIT:				
Borrow	Select soil other than gravel and sand	Embankment and subgrades	Dry -----	Earth moving equipment, dozer, power shovel, rooter, front loader, or dragline
Gravel: (Bank-hill)	Gravel and sand with clay	Base courses, surfacing, and fills	Dry -----	Power shovel, front loader or hand
(Alluvial)	Clean gravel and sand	Aggregate for concrete and bituminous mixes	Wet (or dry)	Earth moving equipment, dragline, power shovel, clamshell, or hand
Miscellaneous (dumps)	Mine spoil, slag, cinders, etc.	Surfacing and aggregates	Dry -----	Power shovel, front loader or hand
QUARRY:				
Hard rock[1]	Aggregate	Base courses, surfacing, and aggregate for concrete and bituminous mixes	Dry -----	Drilling tools, blasting, power shovel, crushing, screening (and washing) plant
Medium rock[2]	Aggregate	Base courses, surfacing	Dry -----	Drilling tools, blasting, power shovel and crushing, screening (and washing) plant
Soft rock[3]	Cementaceous material	Base courses and surfacing on roads and airfields	Dry -----	Rooter, power shovel, earth moving equipment

[1]Hard rock—granite, trap, schist, gneiss, etc.

[2]Medium rock—some limestone, some sandstone, etc.

[3]Soft rock—soft coral, tuff, caliche, chalk, some limestone, some sandstone, laterites, etc.

A DIAGRAM SHOWING A COAL MINING OPERATION. THIS TYPE OF PATTERN INDICATES A STRIP-MINING OPERATION

FIG. 4 MINING OPERATIONS

Mining operations is another type of extraction industry which impacts significantly on military operations. Mining activities, such as coal, bauxite, zinc, copper, lead and sulfur are useful for the production of military hardware and software.

The following is a list of photo identification characteristics which aids in identifying mining operations:

- Mine shafts
- Mine headframes
- Conveyors, power shovels
- Mine cars
- Trucks

- Location of steel production plants—governed by the proximity of coal, limestone, iron ore mining
- Bedding exposures on sides of hills
- Dredges/hydraulic devices
- Cleared vegetation with bedrock fractured by systematic blasting
- Elongated piles of waste material (overburden) placed in previously dug trenches.
- Few small temporary buildings
- Organization at site looks disorganized
- Stacks of construction materials (lumber, pipings)

Most surface and underground mining operations exhibit characteristic patterns/signatures which enable their identification on medium and large scale photographs.

The following are general photo identification characteristics used for recognizing extraction facilities:

- Excavation pits
- Mine head frames and shafts
- Bulk materials stored in piles
- Dark toned sludge ponds
- Piles of waste materials
- Few small temporary buildings
- Bedding exposures in sides of hills
- Clear vegetation with bedrock fractured by systematic blasting
- Operations appear disorganized
- Storage bins/tanks
- Conveyors
- Cranes
- Power shovels
- Mine cars/trucks
- Derricks
- Drilling rigs
- Pipelines

Use of these photo interpretation keys, combined with any additional knowledge of the geographic location and its geologic makeup, will help you identify these facilities accurately.

TEC LESSON

PRACTICE EXERCISE 1

1. Name two types of extraction facilities:

   a. _____

   b. _____

2. What type of extraction facility is indicated by the following PI keys: _____
   - Grid-like road net in area of operations
   - Pumps
   - Drilling rigs
   - Storage tanks

3. What type of extraction facility is indicated by the following PI keys: _____
   - Power shovels
   - Bedding exposures in sides of hills
   - Conveyors
   - Crusher

4. Which PI key identifies a mining operation:
   a. Pumps
   b. Derricks
   c. Elongated piles of waste
   d. Storage tanks

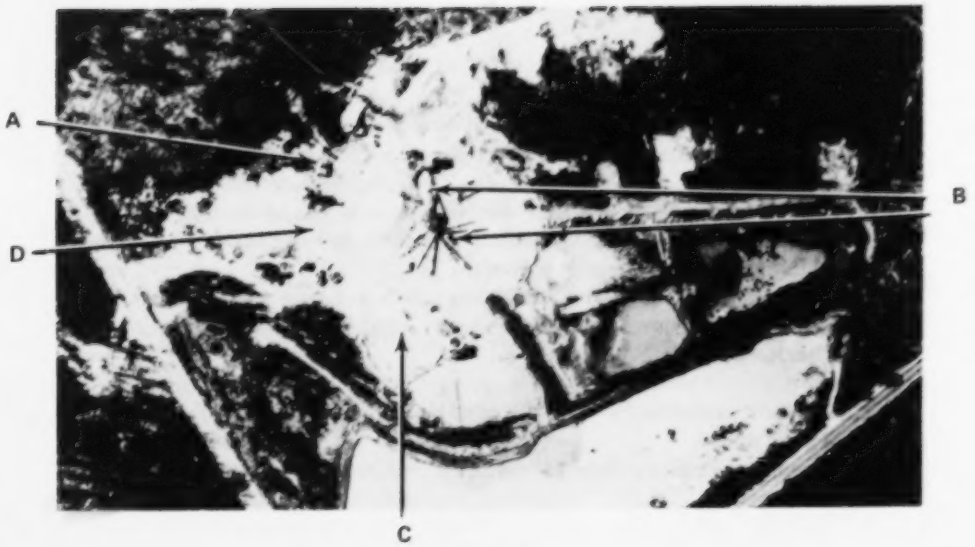


FIG. 1

5. Identify the following PI keys: (Figure 1)

   A _____

   B _____

   C _____

   D _____

Turn to the next page to check your answers

SOLUTIONS TO PRACTICE EXERCISE NO. 1

1. Petroleum, pits and quarries, mining
2. Petroleum
3. Quarry
4. (c) Elongated piles of waste
5. Identify the following PI keys:

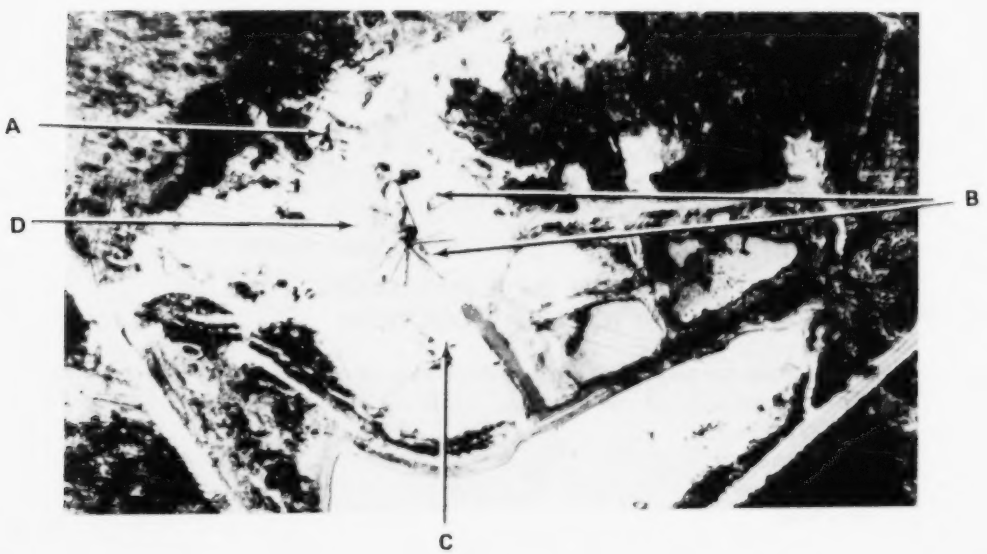


FIG. 1

A Temporary building
B Conveyors
C Power shovel (dragline)
D Pile of extracted material

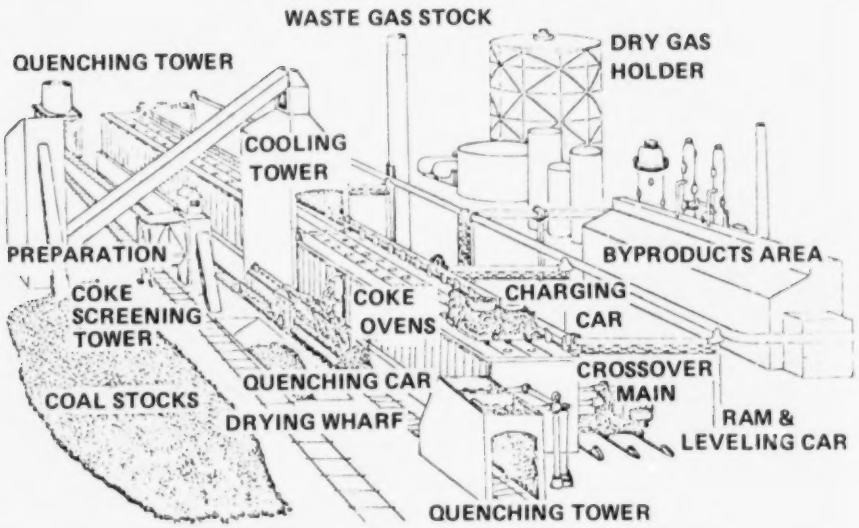


FIG. 5. LAYOUT OF A PROCESSING FACILITY (COKE PRODUCTION)

Processing industries are facilities that produce a usable product by changing the physical form or appearance of raw materials. There are three general types of processing facilities. These are:

- Mechanical
- Chemical
- Heat

Mechanical Processing Facilities

These plants sort, size separate or change the physical form or appearance of raw materials. Examples are sawmills, grain mills and ore concentration plants.. Utilities

Utilities which are considered mechanical processing facilities include hydroelectric power plants, water purification and sewerage disposal installations. Figure 6 illustrates one lay-out of a mechanical processing facility.

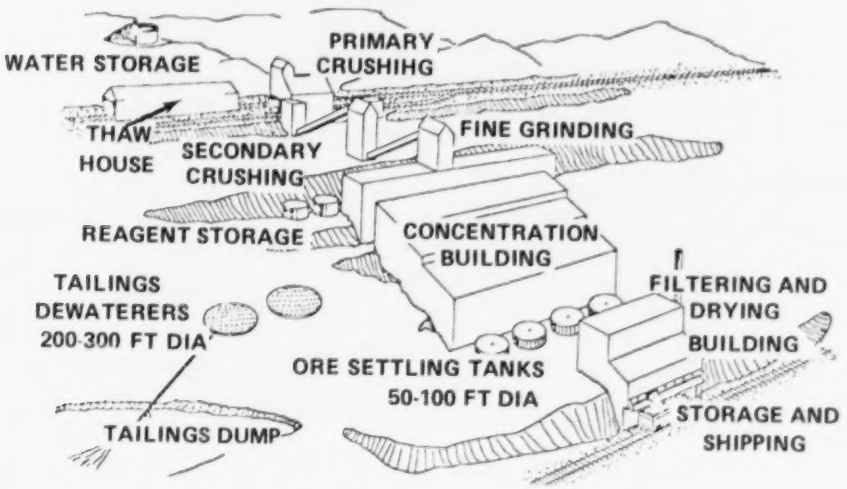


FIG. 6. ORE — CONCENTRATION

The following is a list of major photo identification characteristics for mechanical processing facilities:

- Thaw house – may have a smoke stack or be served by a steam line for a boiler house
- Crushing building – raw ore is unloaded next to this building
- Settling tanks
- Tailing dewaterers
- Main processing buildings are in a straight line and situated on a slope
- Large, light-toned tailings disposal area
- Large and long, low sheds or open stockpiles
- Conveyor systems
- Dusty appearance
- Filter press building may have sawtoothed roof
- Rotary kilns – long pipeline furnaces; may have smoke stacks
- Little fuel in evidence
- Large outdoor processing equipment
- Piles or ponds of waste
- Few pipelines or closed tanks

FIG. 6B. A MECHANICAL PROCESSING PLANT

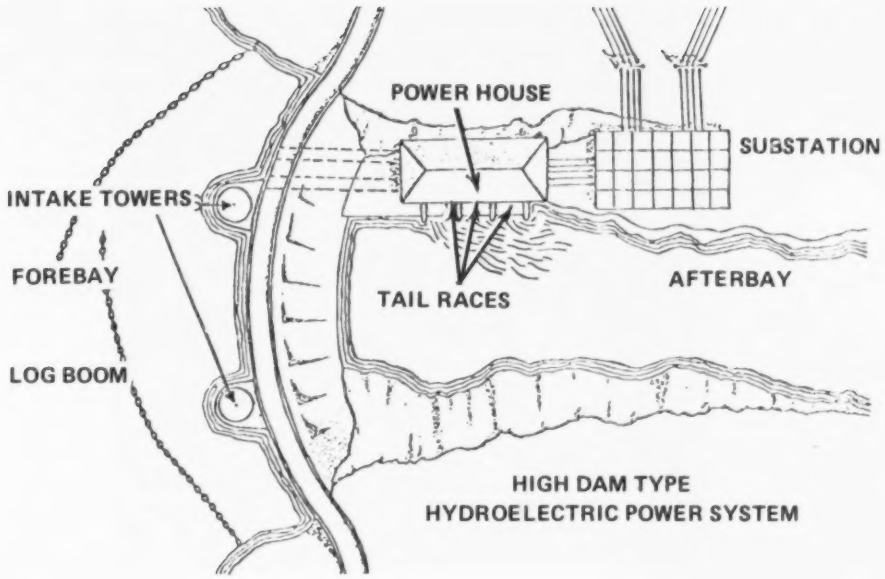


FIG. 6C. HYDROELECTRIC POWER PLANT

Chemical Industries

Chemical processing plants employ chemicals to separate, treat or rearrange the constituents of raw materials. Examples of such industries are sulfuric acid, petroleum refining, rubber processing , plants and oxygen plants.

Figures 7, 8, 9, and 10 are examples of chemical facilities.

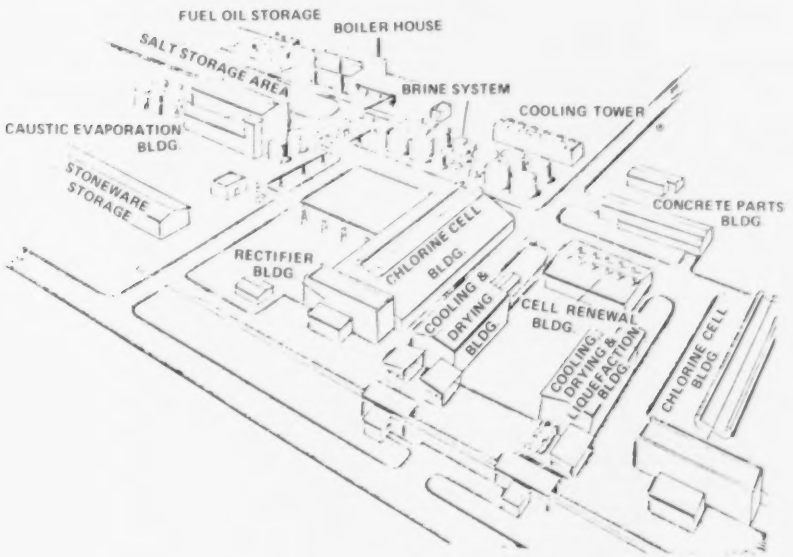


FIG. 7. SKETCH OF CHLORINE PLANT

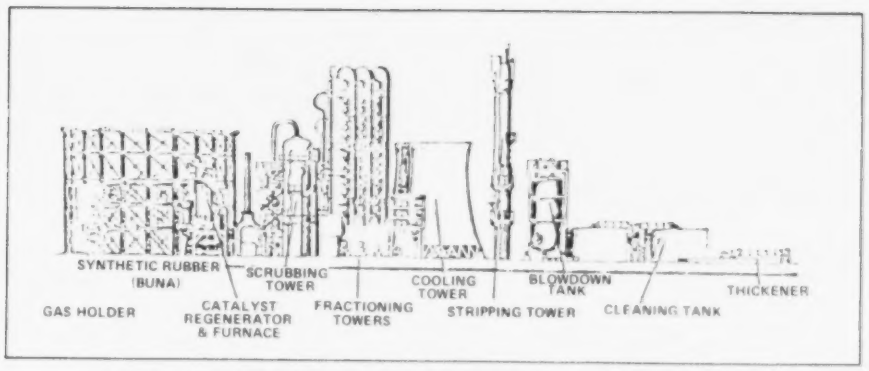


FIG. 8. SKETCH OF SYNTHETIC RUBBER PLANT

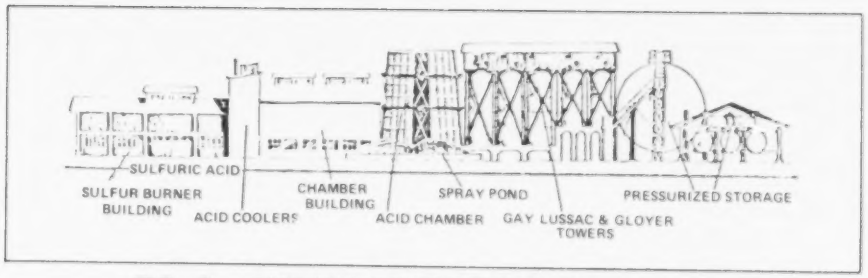


FIG. 9. SKETCH OF SULFURIC ACID PLANT

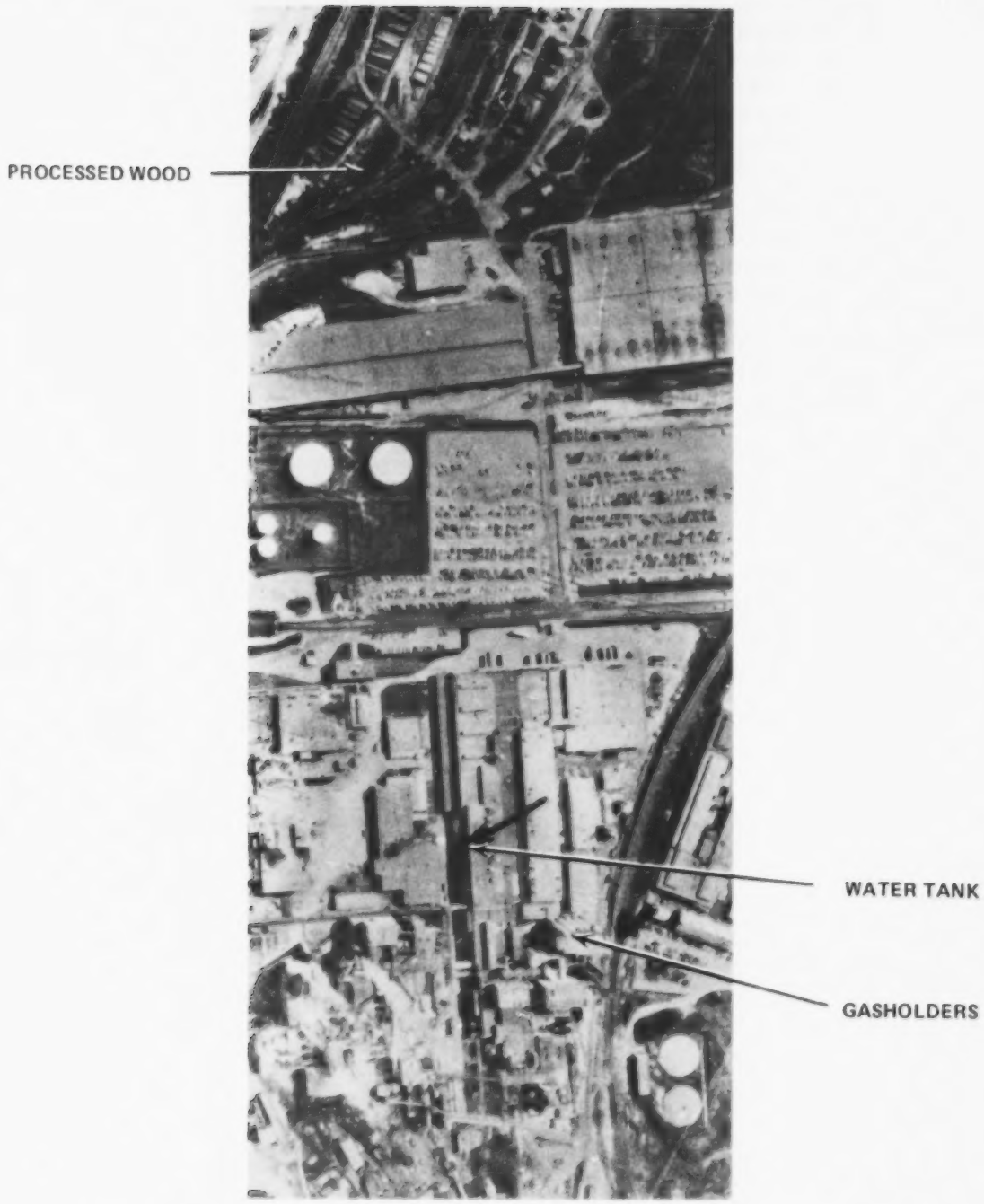


FIG. 10. A CHEMICAL PROCESSING PLANT (WOOD BEING PROCESSED)

Major recognition features used for the identification of chemical industries are:

- Large outdoor processing equipment
- Large quantities of heat or power
- Large complex buildings
- Piles or ponds of waste
- Many closed tanks
- Gasholders
- Pipelines
- Acid storage tanks
- Boiler house
- Absorption towers
- Cooling and drying towers (large body of water)
- Extensive dust staining on roof tops

Chemical industries contribute significantly to military operations because of their high potential for developing chemical weapons and explosives. Therefore, the requirement for an accurate identification of these facilities is very important.

Heat Processing Facilities

Heat processing industries use heat to refine, divide or reshape raw materials. Examples of heating faciliting are:

- Iron and steel refining plants
- Copper
- Lead
- Zinc smelting
- Cement manufacturing plants
- Thermoelectric plants
- Coke and clay production plants

Some of the major recognition features are:

- Few pipelines and tanks
- Large chimneys or stacks
- Large quantity of fuel e.g., coal
- Large complex buildings
- Outdoor processing equipment
- Blast furnaces
- Cooling towers or large body of water
- Good transportation system

Figures 11, 12, 13 and 14 are representive of heat processing facilities.

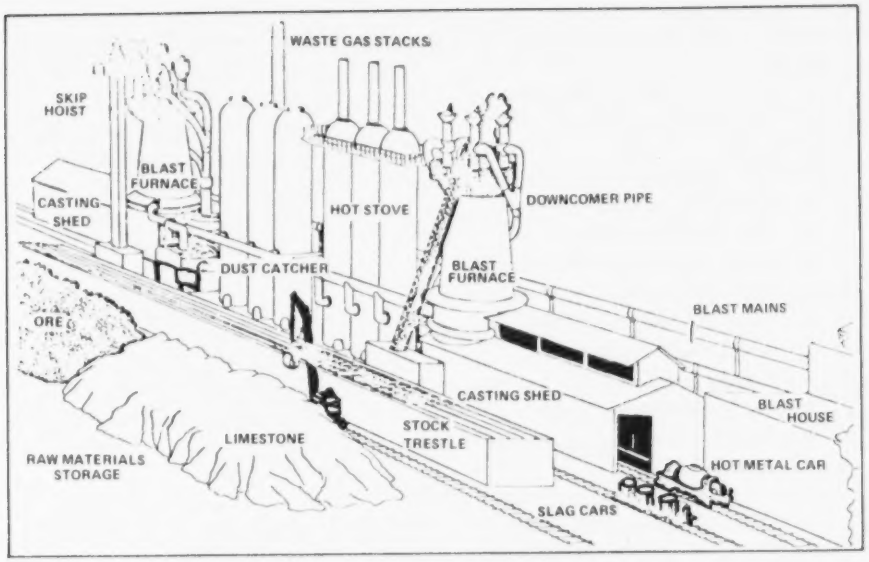


FIG. 11. IRON PRODUCTION

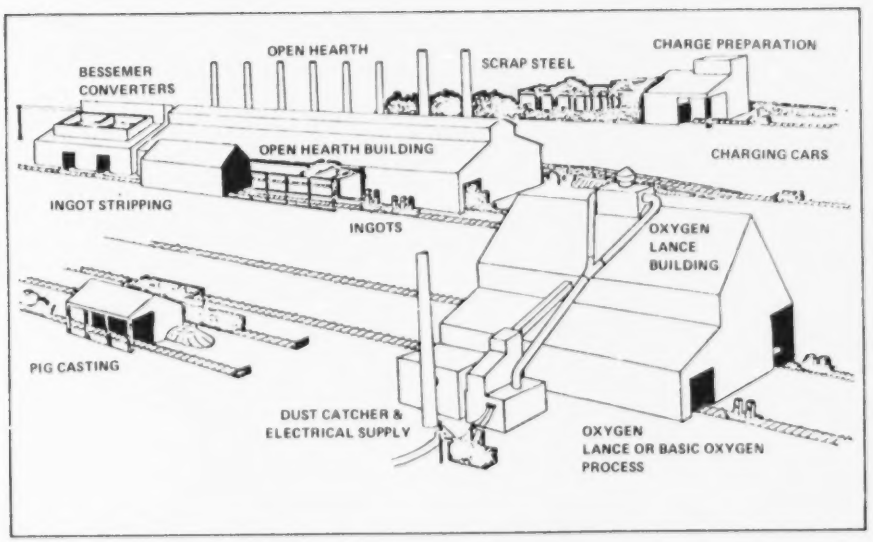


FIG. 12. STEEL PRODUCTION

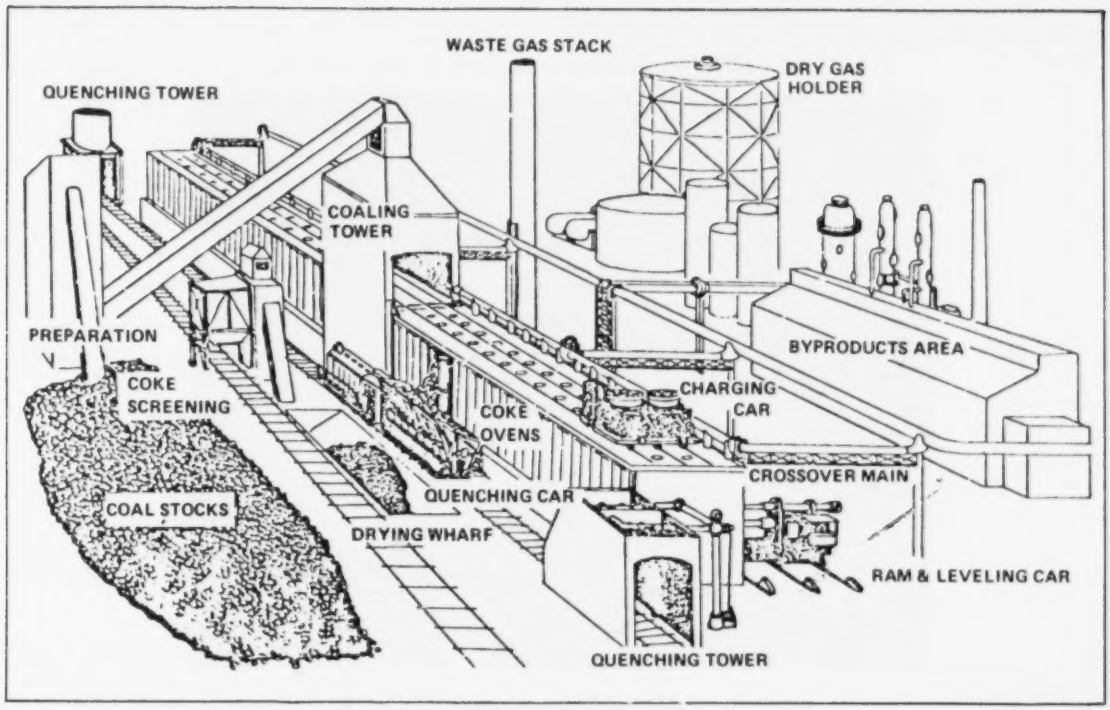


FIG. 13. COKE PRODUCTION

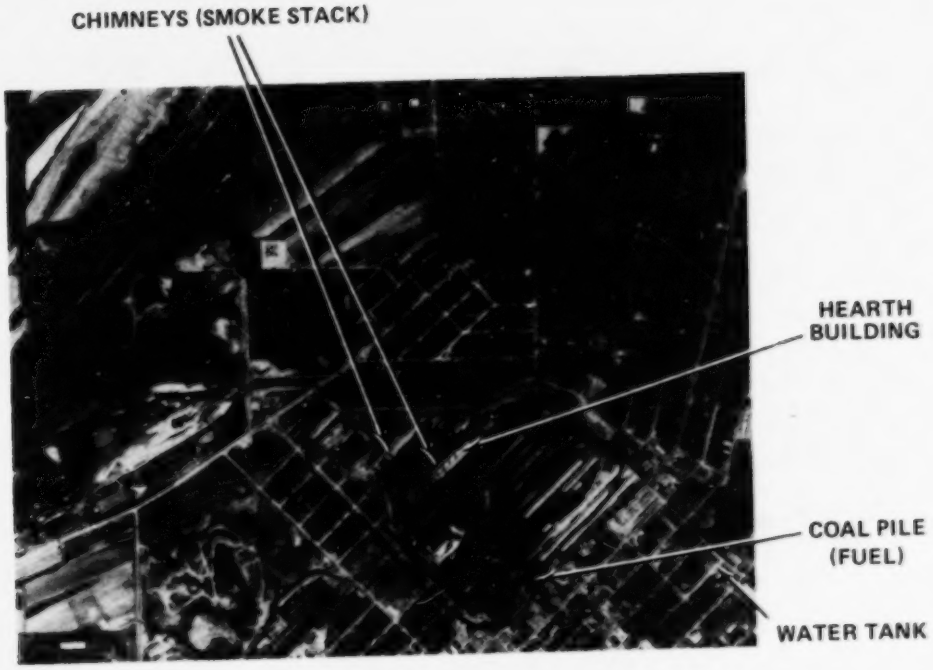


FIG. 14. A HEAT PROCESSING PLANT

PRACTICE EXERCISE 2

1. A chemical processing industry, when viewed on photography, will be characterized by the presence of:
   a. Open storage yards, large complex buildings, heavy equipment
   b. Many pipelines, large outdoor processing equipment, closed tanks
   c. Brick buildings, few storage areas
   d. Stacks, kilns or furnaces, large complex buildings

2. Name the three general types of processing facilities:
   a _____
   b _____
   c _____

3. Which identification characteristic best identifies a mechanical processing plant?
   a. Stacks, chimneys, rotary kilns, conveyor systems
   b. Rotary kilns, outdoor processing equipment, stockpiles
   c. Chimneys, conveyor system, many closed tanks and pipelines
   d. Stacks, rotary kilns, many closed tanks, chimneys

4. If an industry deals with heat processing, one would expect to see:
   a. Large quantity of fuel, many pipelines, little water available
   b. Few stacks or chimneys, no water, small buildings
   c. Blast furnaces, large quantity of fuel, large chimneys or stacks
   d. Large quantity of fuel, no stacks or chimneys, many tanks

5. Identify the following features:

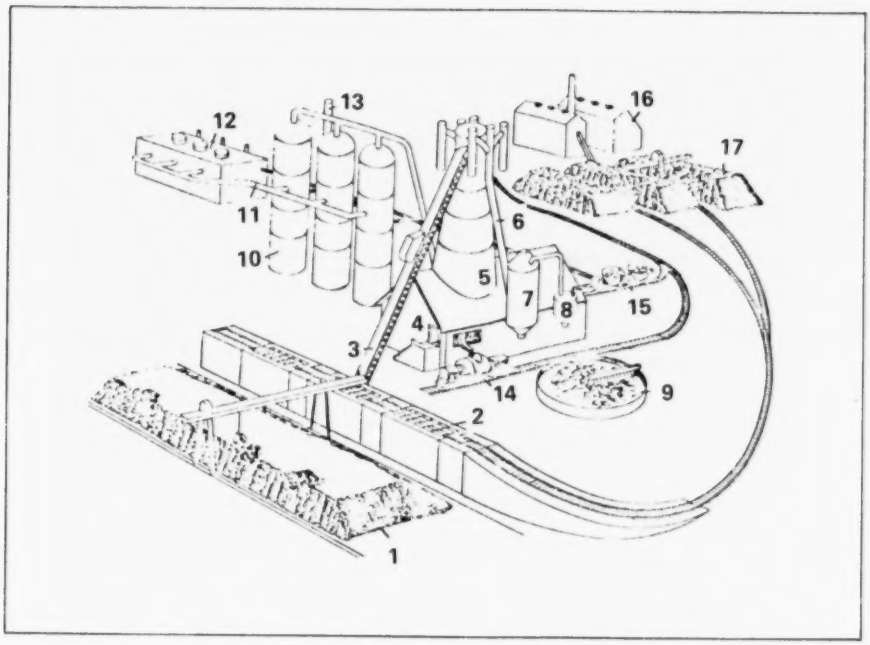


FIG. 1. IRON PRODUCTION PLANT

1. _____

3. _____

5. _____

10. _____

Turn to the next page to check your answers.

SOLUTION TO PRACTICE EXERCISE 2

1. b. Many pipelines, large outdoor processing equipment, closed tanks
2. Mechanial, chemical, heat
3. b. Rotary kilns, outdoor processing equipment, stockpiles
4. c. Blast furnaces, large quantity of fuel, large chimneys or stacks
5. 1. Raw material stockpiles
   2. Conveyor system
   5. Blast furnace
   10. Stoves

Identify Fabrication Industries

Fabrication industries are those industries which manufacture finished products from already prepared or refined raw materials. Identification of a specific fabrication industry is often difficult, because many of the vital image components are hidden inside of buildings. The fabrication industries are divided into two categories:

- Heavy fabrication
- Light fabrication

Heavy Fabrication

This category manufactures large, finished products such as ships and railroad cars. Some Major recognition features are:

- Large steel framed, single story buildings
- Storage yards with heavy lift equipment
- Rail lines entering buildings
- Little or no waste
- Adjacent to airfields, navigable waterways
- Railroad flat cars, flatbed trailers
- Most activities are hidden

Light Fabrication

Light fabrication industries assemble finished products which are not exceptionally heavy or bulky. Examples include aircraft, missiles, motor vehicles, electronic and textile industries. Some of the majo, recognition features are:

- Little or no waste
- Large and small wood framed buildings
- Multi-story structures
- Lack of heavy lift equipment
- Loading platforms
- Closed trailers, vans
- Light lift equipment, e.g., fork lift
- Security fence

Care should be taken not to confuse fabrication industries with storage and handling facilities which are commonly found in or around the outskirts of large towns.

Refer to Fig. 15 for an illustration of a light fabrication facility (aircraft plant).

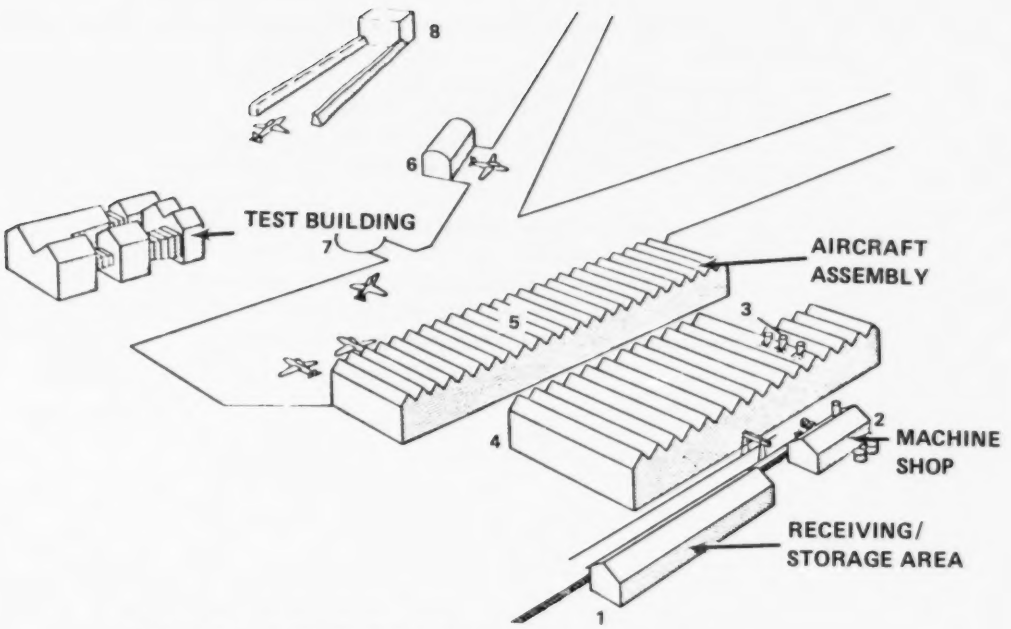


FIG. 15. A SKETCH OF AN AIRCRAFT PLANT

PRACTICE EXERCISE 3

1. A heavy fabrication facility, when viewed on photography, will be characterized by the presence of:
   a. Stacks, steel-framed buildings, furnaces
   b. Lots of waste, stacks, steel-framed buildings
   c. Railroad box cars, lots of waste, steel framed buildings
   d. Steel-framed buildings, heavy lift equipment, railroad flat cars

2. A light fabrication facility will be characterized by the presence of:
   a. Heavy lift equipment, box cars, wood-framed buildings
   b. Closed trailers, vans, loading platforms, light lift equipment
   c. Light lift equipment, railroad flat cars, closed trailers
   d. Closed trailers, heavy lift equipment, lots of waste.

Turn to the next page to check your answers.

SOLUTION TO PRACTICE EXERCISE 3

1. d. Steel-framed buildings, heavy lift equipment, railroad flat cars

2. b. Closed trailers, vans, loading platforms, light lift equipment.

SELF-EVALUATION EXERCISE

This self evaluation is in two parts. Part I is a series of multiple choice questions and Part II is a series of questions which require you to identify industrial facilities from an aerial photograph. This is designed to test your knowledge pertaining to this lesson.

Part I: (6 questions): Select the best answer for each of the muliptle choice questions.

1. Most extraction facilities (e.g., quarries) can be identified by:
   a. Kilns
   b. Few stacks
   c. Excavation pits
   d. Settling tanks

2. Two examples of extraction industries are:
   a. Grain mills/oxygen
   b. Lumber/coal
   c. Oxygen/petroleum
   d. Petroleum/coal

3. Chemical industries (e.g., chlorine) are typified by:
   a. Power shovel/dragline
   b. Conveyors/settling tanks
   c. Gasholders/closed tanks
   d. Conveyors/gasholders

4. Two examples of heating facilities are:
   a. Copper/oxygen
   b. Clay/cement plants
   c. Cement/grain mill
   d. Clay/oxygen

5. Fabrication industries (e.g., canning facilities) are typified by:
   a. Pipelines
   b. Boiler house
   c. Chimneys
   d. Most activities are hidden

6. Processing industries can be divided into three types. These are:
   a. Heat/processing/oxygen
   b. Mechanical/heat/chemical
   c. Processing/mechanical/heat
   d. Chemical/oxygen/heat

PART II; Identify the following features (7 - 10):

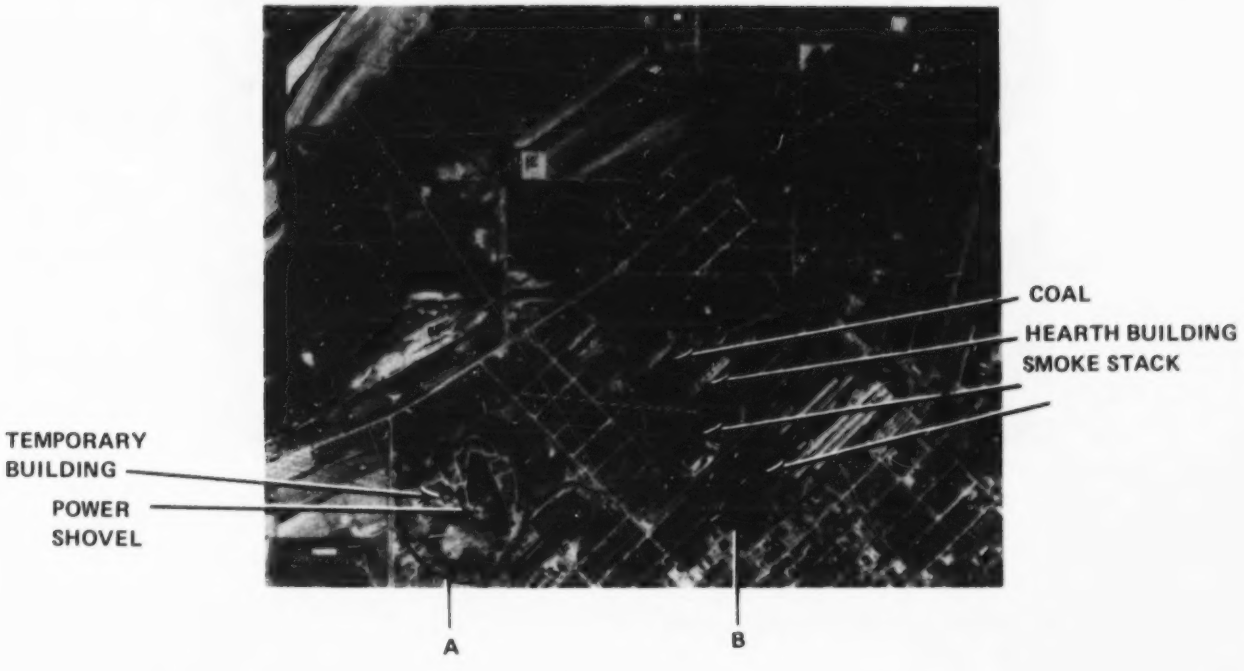
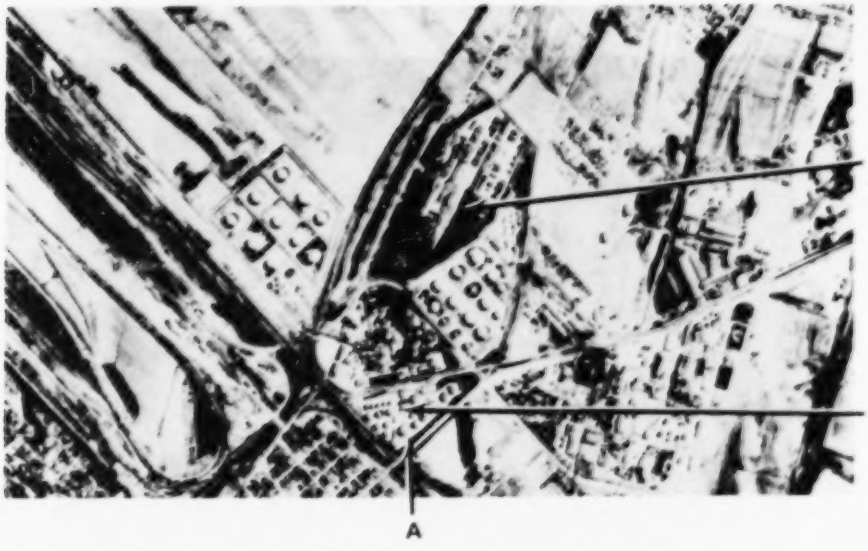


FIG. 1

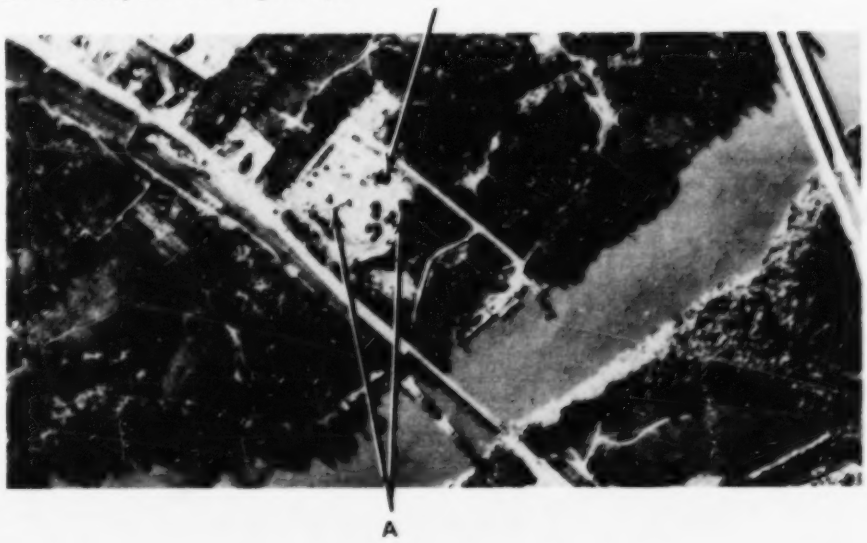
7. Which industrial facility is located at A?
   a. Mechanical
   b. Fabrication
   c. Heating
   d. Extraction

8. Which industrial facility is located at B?
   a. Extraction
   b. Chemical
   c. Heating
   d. Fabrication



9. Identify the industrial facility at A:
   a. Heat
   b. Mechanical
   c. Chemical
   d. Extraction

10. Identify the following PI keys:



ANSWERS TO SELF-EVALUATION EXERCISE

Part I. (Select best response):

1. c. Excavation pits
2. d. Petroleum/coal
3. c. Gas holders/closed tanks
4. b. Clay/cement
5. d. Most activities are hidden
6. b. Mechanical/chemical/heat

Part II (Fig. 1). Identify the following features:

7. d. Extraction
8. c. Heating
9. c. Chemical
10. A – Piles of extracted material (sand)
    B – Conveyor belts

CONCLUSION

If you have any problems with this lesson, review those areas which you do not completely understand. However, if you feel satisfied that you have full knowledge of all aspects of this lesson, take the Posttest.

SOLUTION TO PRETEST/POSTTEST

1. a. Extraction
   b. Processing
   c. Fabrication

2. a. Extraction

3. Petroleum/oil

4. Extraction

5. a. Saw mills, ore concentration, sewage plants
   b. Grain mills, water purification, hydroelectric plants

6. c. Chemical

7. Heating facilities

8. a. Oxygen
   b. Sulfuric acid

9. Heavy fabrication

10. Light fabrication

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